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ABSTRACT

Research findings are reviewed concerning infants' abilities to discriminate parents from other social stimuli during the first 6 months of life. The term "discrimination" is used to signify the ability of infants to respond differentially to two or more social stimuli. Studies reviewed are categorized in terms of the visual, auditory, multisensory, and intermodal sensory modalities investigated. Within each category, evidence of discrimination was evaluated for two groups: infants less than 12 weeks old and those from 12 to 26 weeks of age. This demarcation was made because the literature to date suggests, especially in the visual domain, that the most controversial evidence involves infants younger than 12 weeks. Supplementing the review of literature are appended tables summarizing 21 visual discrimination studies, 14 auditory discrimination studies, 25 multisensory studies, and 10 studies of intermodal person knowledge. Implications for theoretical and clinical issues in infant social development are briefly explored. (RH)

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The Infant's Construction of His Parents in the First Six Months of Life

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The Infant's Construction of His Parents in the First Six Months of Life

That infants are considerably more sophisticated in their behavioral capacities than was once thought is one of the general truths that has emerged from infant development research over the past two or three decades. An aspect of that sophistication is infants' early sensitivity to, and interest in, social stimuli. Bowlby (1969, ch. 14), for example, advanced the notion that infants were predisposed to respond in "special ways" to a variety of stimuli that commonly come from humans. This inborn bias, in Bowlby's view, was a factor that facilitated the development of infant attachments.

Whether or not such a bias exists, the development of infants' understanding of social stimuli is a topic of importance in its own right. In this chapter, I review what is known about the infant's ability to discriminate his/her parents from other social stimuli during the first six months of life. Although discrimination ability per se has been conceptualized as a relatively early phase in attachment relations (see Ainsworth, 1973), its development has relevance for a general understanding of how the infant comes to "know" his/her parents. Following the review, I consider briefly the implications of the data for both theoretical and clinical issues in infant social development.

In this chapter, the term discrimination will be used in its most general form; that is, it will signify the ability of infants to respond differentially to two or more social

stimuli (e.g., mother vs. stranger). Because social stimuli are characterized by many variables that also characterize nonsocial stimuli, mere discrimination between social stimuli does not provide direct evidence that the infant appreciates their social nature (Sherrod, 1981). Moreover, discrimination as such need not imply that the infant has recognized, for example, his/her parent qua parent. As will be seen, however, some of the studies that are reviewed have employed methodologies in which information on recognition of, or preference for, a particular social stimulus can be inferred. For the purposes of this review, however, these behaviors are simply viewed as higher order levels of discrimination skill.

The studies reviewed were categorized as a function of the sensory modalities investigated. This resulted in four major categories: visual, auditory, multisensory, and intermodal. Within each category, evidence of discrimination was evaluated in two age groups--less than 12 weeks and 12-26 weeks. This demarcation was made because the literature to date, especially in the visual domain, suggests that the most controversial evidence involves infants younger than 12 weeks (see Olson, 1981). Although single-sensory studies place maximal demands on infants' discrimination skills, they require fewer inferences about the basis of the discrimination when it occurs. It could, however, be argued that this precision is obtained at the expense of ecological validity, inasmuch as infants typically experience social

stimuli through multiple sensory modalities in everyday life; hence, mulitisensory studies approximate the "conditions of acquisition" (Olson, 1981) more closely than do single-sensory studies, although the basis of the discrimination is more difficult to judge. In any case, it remains an empirical question whether single-sensory vs. multisensory information is a factor that affects infants' discrimination abilities in the first few months of life.

VISUAL DISCRIMINATION

Table 1.1 presents information from 20 studies that assessed infants' ability to discriminate their parents from other social stimuli on the basis of visual information alone. Of these studies, 12 included 17 groups of infants younger than 12 weeks of age. Evidence of discrimination was reported in 4 of the 17 groups (Bushnell, 1982; Carpenter, 1973; Maurer & Salapatek, 1976).[1]

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insert Table 1.1 about here

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Carpenter (1973) tested 19 female infants weekly between 2 and 7 weeks of age and measured looking behavior at sequential exposures of the mother and a stranger. It was reported that the infants looked longer at the mother than at the stranger, whereas closed eyes and peripheral viewing occurred for longer periods of time during exposure to the stranger. Maurer and Salapatek (1976) found that 5-week-old infants, but not 9-week-olds, looked significantly less at

the mother's mirror-reflected face than at the mirror-reflected faces of male and female strangers. More recently, Bushnell (1982) reported evidence for discrimination of mother from stranger in 5- and 11-week-olds, using a variant of the infant control procedure (Horowitz, Paden, Bhana, & Self, 1972). Infants were habituated to a variable number of presentations of the mother's face, and then, under certain conditions (see below, p. 7), showed significant recovery to presentations of a stranger's face, as judged by an increase in the duration of visual fixation.

The strength of Carpenter's (1973) findings may be questioned in a number of ways. First, there appears to be a sampling bias. Aside from testing only females, infants were preselected on the basis of their "visual activity" (see Carpenter, 1974), presumably as judged during their stay in the hospital nursery (see Carpenter, Tecce, Stechler, & Friedman, 1970). Second, as Olson (1981) has pointed out, the use of only one stranger, as was the case in Carpenter's study, confounds the role of stranger with a specific person. This makes it difficult to determine whether discriminations were based on a general attribute of social identity, such as familiarity, or on the idiosyncratic characteristics of a particular stranger (cf. Sherrod, 1979, 1981). Melhuish (1982), for example, failed to replicate Carpenter's (1973) findings with 3- to 5-week-olds but found, in post hoc analyses, that the adults with greater "contrast value" (dark hair, white faces) elicited significantly longer looking than

did the adults with lesser contrast value (light hair and white faces). Of the 17 groups of infants under 12 weeks of age, 9 were exposed to only one stranger. Of the 8 instances in which groups of infants were exposed to more than one stranger, the stranger was systematically varied in only 2 (Bushnell, 1982; Sherrod, 1979).

A third criticism of Carpenter's (1973) study is that the observers were apparently not blind to the identity of the social stimuli. As noted by Contole and Over (1979), knowledge of contextual information (e.g., adult social identity) can bias ratings of infant behavior. Removing this source of bias is important for infant social discrimination research, where the proportion of variance accounted for by social identity tends to be small. Fortunately, the majority of studies for which information is available employed observers who were blind to the identity of the social stimuli (see Table 1.1).

Finally, it should be noted that Carpenter's (1973) statistical analyses are difficult to evaluate; for example, data were collapsed across weeks, so it is not clear at what point discriminations emerged. In addition, the visual condition was analyzed in conjunction with other conditions though inspection of Carpenter's data does suggest that infants looked longer at mother's face than at stranger's face at each weekly interval. In any case, the statistical information in Carpenter's reports is insufficient to give it a fair appraisal.

In Maurer and Salapatek's (1976) study, it is of interest to note that 57% of the fixations of their 5-week-olds were "off the face entirely." Because most of the on-face fixations were directed to the perimeter, it was suggested that the discrimination was based on differences in the hairline or chin of the adults. In any case, the robustness of their findings is uncertain, given that Haith, Bergmann, and Moore (1977), using a similar methodology, failed to find evidence for discrimination in infants 3-5, 7, and 9-11 weeks of age.

In Bushnell's (1982) study, infants were visually habituated to a colored slide of the mother's face in each of five forms: in its normal state and with various features "standardized" (i.e., to equate it with the stranger's face; see below): the eye area, the hair, the mouth, and the eyes and hair. Following habituation to each variant of the mother's face, a stranger's face in equivalent form was made available for visual inspection for three 30-second trials. Compared to a control condition, in which the mother's face was shown throughout habituation and test, both 5- and 11-week-olds showed evidence of recovery to the stranger's face in its normal state and when the eyes and mouth were standardized. As with Maurer and Salapatek's (1976) findings, the basis of the discrimination appeared to involve only parts of the face.

Laub and McCluskey (1974) employed the infant control procedure with 10-week-olds and failed to find evidence of

discrimination. On the basis of data from individual subjects, they did note that a small number of infants appeared to discriminate mother from stranger. Although the studies by Bushnell and Laub and McCluskey are comparable in some respects (e.g., mode of stimulus presentation), other differences preclude definitive conclusions regarding their contradictory results.

Table 1.1 also provides information from 15 studies that included 23 groups of infants 12 to 26 weeks of age. At least some evidence of discrimination was reported in 14 groups (mean age, 14.8 weeks), whereas no evidence of discrimination was reported in 9 groups (mean age, 15.7 weeks). Thus, it appears that there is some support for the idea that parent-stranger discrimination is more consistently obtained beginning around 12 weeks of age, at least on the basis of visual information alone. Nevertheless, the failure of a number of studies to find evidence of discrimination requires explanation. Fortunately, these studies provide sufficient information regarding factors other than age that might influence infants' discrimination abilities. Three factors were identified that appeared related to positive evidence of discrimination: sex of infant, measurement sensitivity, and stimulus exposure time.

Of the 14 groups of infants in which at least some evidence of discrimination was found, 12 groups were evaluated for sex differences. For 6 of these groups, sex of infant effects were reported for at least some measures. In

all cases, only females appeared to show evidence of discrimination (Barrera & Maurer, 1981 [phase 1]; Bernard & Ramey, 1977; Brown, 1975; Watson, Hayes, Vietze, & Becker, 1979). Age and number of subjects did not distinguish the studies reporting sex differences from those that did not (Barrera & Maurer, 1981 [phase 2]; Bigelow, 1977; Fitzgerald, 1968; Maurer & Heroux, 1980; Sherrod, 1979). It is always tempting to try to explain sex differences even though it is often found that such differences are not replicable. In the present set of studies, no discernible pattern could be detected to account for the studies that found sex difference vs. those that did not. In some of the studies, however, the robustness of the sex difference itself appeared dubious. For example, Brown (1975) reported a significant interaction of infant's sex, stimulus type (of which visual information was one level), and social identity for visual fixation. Simple effects analyses indicated that female infants looked longer ($p < .10$) at one of the adults (which one not specified), whereas male infants did not show differential looking times. The extent to which female infants tend to be somewhat better than male infants at discriminating familiar and unfamiliar faces is consistent with Kronitz's (1980) conclusion that in early infancy female infants are somewhat better at visually discriminating "complex" stimuli.

Tests for sex differences were not reported in 7 of the 9 groups in which evidence of discrimination was not found

(Barrera & Maurer, 1978 [phase 1]; Contole & Over, 1981; Lewis & Hurowitz, 1977; Wahler, 1967; Watson, 1966). It is not clear whether this reflected an oversight of the authors or was simply an effort to conserve space rather than present a "no effect" result.

Measurement sensitivity appears to contribute to the general absence of discrimination reported in two studies by Watson and his associates (Hayes & Watson, 1981, Exp. 2; Watson, 1966). In one study (Hayes & Watson), in which infants viewed the adult stimuli sequentially on videotape, floor effects seem to have occurred, with duration of smiling as the dependent measure. In an earlier study (Watson, 1966), in which the adults were presented live, the duration of smiling was longer, though, in general, it was close to the floor. In the study by Watson et al. (1979), floor effects did not appear as strong, but the evidence of discrimination was complicated by an interaction with the facial orientation of the social stimuli and the infant's sex. Female infants smiled longer at mother than at stranger when viewed at 0^0, whereas male infants smiled longer at mother than at stranger when viewed at 90^0. Given Hayes and Watson's (1981) subsequent report that order of stimulus presentation also influenced these data, it is questionable whether the findings are replicable. Floor effects with regard to smiling are also present in the studies by Brown (1975), Lewis and Hurowitz (1977), and Wahler (1967). On the whole, it appears that smiling is a particularly difficult

behavior to elicit when the infant is exposed to a visually silent adult, at least within the age range under consideration.

Maurer and her associates (Barrera & Maurer, 1978, 1981; Maurer & Heroux, 1980) have argued that fixed exposure times may prevent infants from encoding, or becoming familiar with, the to-be-discriminated stimuli (cf. Horowitz, 1974; Horowitz et al., 1972). For example, Barrera and Maurer (1978) found that two 20-second exposures of mother and stranger's photographed face in a paired-comparison test did not yield evidence of discrimination; however, following a 100-second familiarization period in which infants could look at the mother's photographed face, they preferred to look at the photograph of a novel stranger in a paired-comparison posttest. In three other experiments, evidence of discrimination was found using the infant control procedure, or variants of it (Barrera & Maurer, 1981; Maurer & Heroux, 1980). The importance of allowing the infant to control the duration of stimulus exposure is illustrated by Barrera and Maurer's (1981) finding that the mean time to habituation was 452 seconds, which is considerably longer than the average exposure time in most of the visual discrimination studies. One notable exception is Wahler's (1967) study, in which, as judged by frequency of smiling, discrimination between mother and stranger was not found following 5 minutes of exposure to each person. As noted earlier, smiling appears to be a behavior subject to floor effects in this kind of research.

In general, however, inspection of Table 1.1 suggests a positive association between stimulus exposure time and evidence of discrimination among infants 12 weeks of age and older.

AUDITORY DISCRIMINATION

Table 1.2 presents information from 12 studies that assessed infants' ability to discriminate their parents from adult strangers on the basis of auditory information alone. Infants under the age of 12 weeks were tested in 8 of these studies. With the exception of Lewis and Hurowitz (1977), the remaining 7 studies reported at least some evidence of discrimination. DeCasper and Fifer (1980), for example, described two experiments in which infants younger than 3 days of age modified their patterns of nonnutritive sucking in order to hear the mother's voice rather than the voice of a female stranger. Similar findings have been reported by Mills and Melhuish (1974) and by Mehler, Bertoncini, Barriere, and Jassik-Gerschenfeld (1978). The studies by DeCasper and Fifer (1980) and Mills and Melhuish (1974) utilized a methodology to detect preference, rather than discrimination per se, in that infants could control either the duration or the identity of the social stimuli by varying their sucking rates. In both studies, infants preferred to hear the mother's voice.

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In three studies conducted in the home, Hulsebus (1975, 1981, 1983) examined suppression of crying as an index of discrimination in infants younger than 3 weeks of age. In the first experiment, Hulsebus (1975) tested 2-week-olds and after 60 seconds of continuous crying exposed the infants to either 60 seconds of the mother's voice or 60 seconds of a female stranger's voice. After a few minutes, the procedure was repeated a second time and the infants heard the other adult's voice. Infants were more likely to suppress their crying, at least for a time, when exposed to the mother's voice; for example, of 14 infants who paused at least once in their crying, 11 did so sooner to the mother's voice than to the stranger's voice. Hulsebus (1981, 1983, Exp. 2) reported similar findings for discrimination of father's voice from a male stranger's voice for infants 1 and 2 weeks of age. Infants 3 days of age (Hulsebus, 1983, Exp. 1) tended to suppress their crying sooner to the father's voice than to the stranger's voice but the difference was not significant. Methodologically, the major limitations of these studies include the use of only one stranger and nonblind scoring. In addition, tests of order effects were not made.

Boyd (1974) used the infant control procedure and reported some evidence of discrimination in 8-week-olds. In an ABCB design, experimental group infants were first habituated visually to a checkerboard square (A). Infants then heard either the mother's voice (B) or a stranger's

voice (C) each time they looked at the checkerboard (phases BCB). Each phase ended once the infant reached a predetermined habituation criterion. Control group infants were habituated visually to the checkerboard (A) and then heard the stranger's voice (C) for three phases. Boyd found greater recovery of visual fixation following stimulus change from mother's voice to stranger's voice as compared to the visual behavior of the control infants ($p < .05$, one-tailed). In the C to B phase, however, experimental infants' visual recovery was not significantly greater than that of the control group. In a session conducted one week earlier with the same infants, Boyd found that visual recovery to the target occurred when it was accompanied by either the mother's voice or the stranger's voice. The design permitted an evaluation of whether there was a difference in the degree of recovery as a function of voice. Although Boyd argued that the infants were more responsive to the stranger's voice, virtually all comparisons on which this conclusion was based involved data that only approached significance.

Table 1.2 also includes information from 5 studies that included 6 groups of infants 13 to 25 weeks of age. Neither Lewis and Hurowitz (1977) nor Turnure (1971) found convincing evidence of discrimination. For example, Turnure reported that 13-week-olds engaged in more mouthing when exposed to the mother's voice than when exposed to the stranger's voice but 17 other comparisons at 13, 25, (and 39) weeks were not significant. In both studies, the number of infants tested

was small.

Brown (1975) exposed 13-week-old infants to four consecutive presentations of the mother's voice and a stranger's voice, respectively. Order of presentation was counterbalanced across infants. Neither duration of visual fixation toward the locus of voice nor smiling differentiated the infants' behavior in the two conditions. Brown did find that infants vocalized longer in the mother-stranger sequence than in the stranger-mother sequence and, on this basis, concluded that there was evidence of mother-stranger discrimination. Given the sequence effect, clearly an unanticipated finding, and the low level of vocalization (grand mean, .71 sec), it is unlikely that this finding is replicable.

In another study, Brown (1979) measured the vocal responses of 16-week-old infants to three voice presentations of mother, father, female stranger, or male stranger in a between-subjects design. The results were complex and equivocal. Infants who heard the mother's voice tended to vocalize longer than did infants who heard a female stranger's voice ($p < .10$). Inspection of Brown's data suggests that this effect was accounted for primarily by female infants. Female infants who heard the father's voice vocalized less (in fact, not at all) than did female infants who heard a male stranger's voice. Male infants showed a similar pattern in these two conditions, but the difference was not significant. Given the complex interactions, the

robustness of the findings is dubious. In general, Brown's measure was subject to floor effects; on average, infants vocalized less than 1 second per 30 second interval of time.

Bosso (1978) employed an operant paradigm in which 20-week-old infants pulled a string attached to their wrists in order to activate either the mother's voice or a stranger's voice. As judged by the frequency of arm pulls, infants preferred to hear the mother's voice. There was also some evidence of greater alerting and visual search during the episode in which the mother's voice could be heard. Thus, using developmentally more mature responses, Bosso's findings appear to parallel the findings with neonates in which nonnutritive sucking was employed as the operant.

On the whole, the auditory discrimination studies appear to provide stronger evidence of discrimination in the first 12 weeks of life than do the visual discrimination studies, a pattern that is consistent with an early clinical impression (Wolff, 1963). There are a number of ways in which the apparent superiority of infants' auditory discrimination might be explained. First, some of the successful auditory studies provided infants with operant control over the social stimuli, a procedure that was not utilized in the visual studies. Second, stimulus exposure times appear to be considerably longer in the auditory studies than in the visual studies (see Table 1.2). For example, DeCasper and Fifer's (1980) test trial lasted 20 minutes. With the general exception of the studies employing the infant control

procedure, the experiments in the visual domain rarely approach this length of time. That exposure time may be important in the auditory domain is suggested by Experiment 2 in DeCasper and Fifer (1980), in which discrimination of the mother's voice from the stranger's voice occurred only in the last third of a 20-minute trial. Interestingly, in the five studies in which discrimination in the auditory domain was not found (Hulsebus, 1983 [Exp. 1]; Lewis & Hurowitz, 1977) or was equivocal (Brown, 1975, 1979; Turnure, 1971), exposure times tended to be brief. For example, in the studies by Brown the actual amount of time the adults spent talking was quite small, even though the total trial duration per adult ranged from 92-180 seconds (see Table 1.2).

A third explanation for the apparent superiority of infants' auditory discrimination hinges on the relative development of the visual and auditory sensory systems. A number of researchers have noted that at birth the auditory system is closer to "mature" functioning than the visual system; hence, infants may be capable of making more sensitive discriminations between voices than between faces. However, until potentially confounding factors (e.g., exposure times, response measures) are equated in the visual and auditory research, this interpretation remains speculative.

A fourth explanation, advanced by DeCasper and Fifer (1980), is that before birth neonates have become familiar with the mother's voice. In fact, Spence and DeCasper (1982)

have recently provided evidence that fetuses in the third trimester of gestation perceive maternal speech.

Finally, there is intriguing evidence from the comparative literature that auditory information may be more salient than visual information in eliciting attachment responses, at least during the first few days of life. For example, Johnston and Gottlieb (1981) found that domestic mallard (Peking) ducklings were more likely to follow an unfamiliar box with red and white stripes that emitted a recording of the mallard maternal assembly call than to follow a stuffed model of a mallard duck to which they had been previously imprinted visually (see Gottlieb, 1981, for a review of this area).

Whatever the reasons for the apparent superiority of auditory to visual discriminations in the first few months of life, it remains important to understand the basis for such discriminations. The majority of the auditory studies that reported evidence of discrimination employed multiple exemplars of strangers' voices, so the discrimination does not appear to be idiosyncratic. There is some evidence that rhythmicity is a factor, since Mehler et al. (1978) found evidence of discrimination when voices were intonated but not when they were in monotone. Most researchers have asked the adults to record or present their voices "naturally," e.g., in a way that might elicit a smile from the infants. Thus, auditory stimuli may have greater ecological validity than do the unsmiling, motionless faces commonly employed in the

visual discrimination studies, i.e., the auditory stimuli approximate more closely what the infant experiences in everyday life.[2]

MULTISENSORY DISCRIMINATION

It was suggested earlier that studies assessing discrimination on the basis of only one sensory modality may have limited ecological validity, since infants generally experience their parents through multiple sensory modalities in everyday life. Accordingly, evidence of discrimination may be underestimated if the infant is provided with only one sensory cue by which to make discriminations. This argument, ceteris paribus, certainly does not seem to hold for the data on auditory discrimination and, with appropriate methodological changes (e.g., Barrera & Maurer, 1981; Bushnell, 1982), may eventually require reconsideration in the visual domain as well. In any case, it remains of interest to evaluate the evidence of discrimination that has been obtained under conditions in which infants are provided with two or more sensory cues (typically, visual and auditory), a situation that corresponds more closely to infants' everyday experience.

Table 1.3 presents information from 24 studies that assessed infants' ability to discriminate their parents from other social stimuli on the basis of multisensory information. Of these, 14 studies included 18 groups of infants under the age of 12 weeks. Evidence of discrimination was reported in 10 groups, whereas lack of discrimination was

reported in 8 groups. Of the 10 groups in which discrimination on the basis of visual and auditory information was found, 3 were also evaluated for discrimination on the basis of visual information alone. Carpenter (1973) reported evidence of discrimination in the visual alone condition, but Bigelow (1977) and Laub and McCluskey (1974) did not. Of the 8 groups in which discrimination on the basis of visual and auditory information was not found, 6 groups were also evaluated on the basis of visual information alone (Haith et al., 1977; Hayes & Watson, 1981, Exp. 2; Lewis & Hurowitz, 1977; Melhuish, 1982), and in no case was discrimination reported. Lewis and Hurowitz also found no evidence for discrimination on the basis of auditory information alone. On the whole, the evidence appears to be somewhat stronger for multisensory discrimination prior to 12 weeks, at least as compared to the visual discrimination studies. However, some of the studies that reported evidence of discrimination are not without their problems.

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In an early study, Banks and Wolfson (1967) measured changes in heart rate to the presence of mother or stranger in infants 6 or 11 weeks old. Relative to a prestimulus alone period, infants at both ages showed a decline in heart rate in the mother's presence, whereas heart rate increased

slightly in the stranger's presence. Unfortunately, Banks and Wolfson's statistical analyses are incomplete and somewhat difficult to appraise. Among the 11-week-olds, for example, the prestimulus heart rate of infants in the mother group appears to be higher than that of infants in the stranger group, thus making it difficult to evaluate the significance of the decline in the heart rate of the former. In addition, Banks and Wolfson's use of only one stranger calls for some caution in concluding that the familiarity variable accounted for the apparent differential changes in heart rate. As was the case for the studies in the visual domain, the majority of multisensory studies employed only one stranger with infants under the age of 12 weeks (12 of 18 groups).

In another early study, Koch (1968) attempted to condition 8-week-olds to turn their heads 90°, following which either the mother or a stranger reinforced them visually and by "speaking kindly." In general, Koch found it "difficult" to establish a conditioned reaction; for example, even after 80 trials, only 10% of the conditioned signals were followed by a conditioned response when the mother was the reinforcer. Although formal statistical analyses were not performed, it does appear that the stranger was a more effective reinforcer than the mother.

In Carpenter's (1973) longitudinal study, it was reported that in the multisensory condition infants looked longer at mother's face than at a stranger's face; however, no

statistical analyses were performed on these data. Carpenter concluded that the face was the most potent factor in controlling differential looking, since infants also looked longer at the mother's face when accompanied by the stranger's voice than at the stranger's face when it was accompanied by the mother's voice. These findings are somewhat puzzling, given infants' apparent sensitivity to maternal voice, as reviewed in the preceding section. In any case, Carpenter's findings require cautious appraisal, given the various methodological constraints noted earlier (pp. 5-6).

Bigelow (1977) reported that 5-week-olds directed significantly longer first fixations to a stranger than to the mother but that the total duration of visual regard was not significantly different. Evaluation of this study is made difficult by the lack of statistical and other information (see Table 1.3).

Laub and McCluskey (1974) used the infant control procedure to habituate experimental group infants to a colored slide of the mother's face that was accompanied by her voice. Following habituation, infants were given the opportunity to look at a female stranger's face accompanied by her voice until habituation occurred. Control group infants were habituated to either the mother's or a stranger's face and voice but did not subsequently experience stimulus change; i.e., they continued to see and hear the same face and voice. Following habituation, experimental

infants fixated the new stimulus significantly longer than the control infants fixated the unchanged stimulus.

Dixon, Yogman, Tronick, Adamson, Als, and Brazelton (1981) studied 5 infants longitudinally between 2 weeks and 6 months of age (weekly, 2 to 6 weeks; biweekly, until 4 months; and monthly, until 6 months). In each session, the infant was videotaped during two minutes of face-to-face interaction with the mother, the father, and a stranger, respectively. Of 60 sessions "for which the interaction...was complete for all three adults and technical quality [of the videotapes] uniform," 16 sessions were chosen for "detailed micro-analysis." Narrative summaries, derived from the videotapes, were used to score on a second-to-second basis four categories of behavior: facial expression, vocalizations, limb movement, and gaze.

Across all sessions, duration and percent time scores were calculated for each behavior. Of the duration measures, 2 of 12 differentiated mother from stranger, 1 of 12 differentiated father from stranger, and 7 of 12 differentiated mother from father.[3] Similar findings were reported for the percent time scores. Three behaviors (frown, smile, no limb movement) were also analyzed to assess the relation between age and parent-stranger discrimination. Between 2 weeks and 2 months, two behaviors differentiated mother from stranger, none differentiated father from stranger, and one differentiated mother from father. Between 2 and 6 months, no behaviors differentiated mother from

stranger, one differentiated father from stranger, and one differentiated mother from father. On the basis of these findings, Dixon et al. concluded that infants "from the first month of life demonstrate the ability to behave differentially in interacting with different persons" (p. 46).

Dixon et al.'s (1981) claims regarding parental discrimination may be questioned on several grounds. First, it is not made clear whether the 16 analyzed sessions were randomly selected, nor is it explained why the remaining 44 sessions were not analyzed. More troubling, however, are the questionable statistical analyses on which their conclusions rest. For example, of 36 comparisons of the infants' behavior, only 5 were statistically significant, 1.8 of which would be expected by chance alone (with alpha = .05). Thus, evidence of discrimination is inferred on the basis of weak findings. Second, neither adult identity nor the time of testing were treated as within-subject factors in an ANOVA design. Dixon et al.'s use of a priori multiple comparisons requires some kind of consideration of increases in Type I errors. Finally, the data on age effects are puzzling; for example, Dixon et al. make no attempt to explain why two behaviors differentiated mother from stranger between 2 weeks and 2 months but none did so between 2 months and 6 months.4

Fogel (1979, 1980) also employed microanalytic techniques in three experiments that focused on early discrimination abilities. In one study, Fogel (1979)

compared the responses of 5-14 week-old infants exposed to two minutes of interaction with mother and an infant peer, respectively. The first 10 seconds of the interactions were scored for the occurrence/nonoccurrence of 34 behavioral categories derived from the infant's "basic body parts."

Based on the results from a discriminant function analysis, Fogel (1979) suggested that the infants' behavior in the two conditions differed along a dimension of "active approach" vs. "receptive gazing." Behavior to the mother, for example, involved "multiple changes in brow expression... accompanied by a variety of [smooth] mouth, limb, hand, and finger movements," whereas behavior to the peer had an "intense, unbroken quality" (e.g., minimal facial movement). Although the robustness of this analysis may be questioned, given the small subject to variable ratio, Fogel did find that 9 of the 34 behaviors were displayed by significantly more infants in one of the two conditions. Two aspects of Fogel's methodology call for some caution in interpreting these findings with regard to discrimination. The mothers talked to the infants during their session, whereas there is no evidence that the infant peers did the same. Thus, differences as a function of social identity are confounded by the sensory information available to the infant. In addition, the mothers were asked to hold the infants during the peer session rather than keep them in an infant seat, as was done during the mother session. Whether this change in "setting" influenced the infants' behavior is not clear.

In another study, Fogel (1980, Exp. 1) assessed 10-week-old infants' separation responses following two minutes of face-to-face interaction with the mother or a stranger. It was hypothesized that "differences between the two absence conditions could be interpreted as showing that cessation of face-to-face interaction with mother has a meaning for the infant which is more than simply a pure response to being alone" (p. 317). The frequency and duration of 14 behaviors were initially coded, but since a number of them occurred infrequently, only 8 were retained for analysis. The majority of these behaviors differentiated the infants' behavior in the two conditions: "infants more readily cried and more often showed distress brow expressions to the mother's absence, and they were more likely to yawn and perform rhythmic mouth movements during stranger absence" (p. 327). Some of these effects occurred in only one of the two orders in which the adults interacted with and subsequently left the infants.

Fogel (1980) suggested that familiarity may have been one variable that accounted for the differential separation responses. To test this idea, a second experiment was conducted, whose only difference from the first was that it was preceded by a 10-minute period during which the stranger, in the mother's presence, was instructed to "talk to, touch, or pick up the infant as it seemed appropriate in the course of 'getting to know' the baby" (p. 325). The results showed no differential responses to maternal vs. stranger absence.

Fogel interpreted these findings as providing support for the view that the prior interaction affects subsequent separation responses and that familiarity with the adult is a factor that contributes to the subsequent responses. To the extent that these findings are valid, it would appear that, at least within this particular context, 10-week-old infants rapidly lose the ability to keep mother and stranger separate. Despite the problems presented by the studies of Dixon et al. (1981) and Fogel (1979, 1980), the use of microanalytic techniques seems worthwhile and should be considered for adoption in future studies on early social discrimination.

In addition to Fogel's (1980) second experiment, evidence of discrimination was not found in 5 other studies that tested 7 groups of infants. Lewis and Hurowitz's (1977) study is difficult to evaluate, given the small number of subjects and the low frequency of occurrence for most of their measures. Hayes and Watson's (1981, Exp. 2) study also appears to suffer from floor effects, at least with respect to the behavior of the 10-week-olds. However, the studies by Haith et al. (1977), Klein and Jennings (1979), and Melhuish (1982) appear to be free from such limitations.

The study by Blehar, Lieberman, and Ainsworth (1977) is of particular interest since it provided data on individual differences in discrimination. Across all infants, only one of seven behaviors (bouncing) resulted in differential responding during naturalistic, adult-initiated face-to-face episodes with mother (n=732) and stranger (n=289); however,

when the infants were subgrouped at 12 months on the basis of their behavior in the Ainsworth Strange Situation (Ainsworth, Blehar, Waters, & Wall, 1978), it was found that the "securely" attached infants had shown greater differential responding than their "intermediately" and "anxiously" attached counterparts earlier in the first year. For example, the securely attached infants were more likely to vocalize and bounce in response to a face-to-face episode initiated by the mother than to one initiated by the stranger. Unfortunately, Blehar et al. did not indicate whether such variations in differential responsiveness were detectable in both their early (6 and 9 weeks) and late (12 and 15 weeks) observations.

Blehar et al. (1977) rejected the argument that the securely attached subgroup was simply more advanced developmentally in a general way, since the three groups did not differ from one another on a test of infant intelligence. Instead, Blehar et al. argued that maternal "sensitive responsiveness" to infant behavioral cues may have promoted the earlier emergence of differential responding in the securely attached infants. Assuming that the groups did not differ in sheer amount of exposure time to mother, it would appear that an important correlate of individual differences in discrimination ability has been identified. In this regard, it is of interest to note that one maternal behavior displayed least often with the securely attached group was "silent, unsmiling" face-to-face encounters. This behavior

is reminiscent of the type of stimulus that has been relatively unsuccessful in yielding evidence of visual discrimination.

In the section on visual discrimination, it was suggested that stimulus exposure time may have been a determinant of infants' ability to distinguish between social stimuli. Inspection of Table 1.3 suggests that this factor may have operated in the studies on multisensory discrimination as well, at least among the infants younger than 12 weeks.

Table 1.3 also provides information from 15 studies that included 23 groups of infants 12 to 22 weeks of age. All but two of these studies (Contole & Over, 1981; Lewis & Hurowitz, 1977) reported at least some evidence of discrimination. Contole and Over's (1981) study is of interest in that it employed signal detection analyses to avoid bias in observer ratings of infant behavior. Their failure to find selective responding (even among infants 30 weeks of age; see Table 1.3) is puzzling. Perhaps the 20-second period that was used to score infant behavior was too short to disclose differences in behavior directed to mother vs. stranger. However, it should be noted that 20 seconds was sufficient to yield differences in behavior as a function of whether an adult was present or absent and interactive or passive. The signal detection analyses indicated that adult social identity was the least powerful stimulus condition with regard to accurate judgments of the social context of

infants' behavior.

Of the 21 groups in which evidence of multisensory discrimination was reported, 6 were evaluated for discrimination on the basis of visual information alone. Bigelow (1977), Brown (1975), and Watson et al. (1979) reported evidence of discrimination based on visual information alone, but Hayes and Watson (1981, Exp. 2) and Wahler (1967) did not. As noted earlier, however, the findings of Brown and Watson et al. in the visual alone condition are of questionable robustness. Thus, although the evidence of multisensory discrimination appears more consistent than does the evidence of visual discrimination, this conclusion is drawn primarily on comparisons across, rather than within, individual studies.

The apparent consistency of the evidence for multisensory discrimination should not obscure the fact that these studies are characterized by a number of methodological deficiencies. Consider first the 8 studies that evaluated evidence of discrimination when mother and stranger were presented in a live mode and their behavior was fixed and noncontingent in relation to the infants' behavior (Bigelow, 1977; Brown, 1975; Cohen, 1974; Klein & Jennings, 1979; Koch, 1968; Lasky & Klein, 1979; Rebelsky, 1971; Watson et al., 1979). The majority of these studies failed to describe their counterbalancing procedures or did so and reported order effects, provided no formal interobserver reliability, employed observers who were not blind to the identity of the

social stimuli, and used only one exemplar of a stranger (see Table 1.3).

Roe's (1978) study was similar to these 8 studies except that the adults apparently could vary their behavior as a function of the infants' responsiveness (p. 113). In a longitudinal design, Roe found that infants tested at 12 and 20 weeks engaged in more nonpretest vocalizations and motor activity with mother than with stranger. Roe also found that the discrimination between the two adults was accounted for primarily by infants with higher Gesell Developmental Quotients, which were obtained when the infants were 36 weeks old. Unfortunately, Roe's study suffers from the same methodological problems noted in the preceding paragraph.

Fafouti-Milenkovic and Uzgiris (1979) examined the behavior of four age groups of infants (14, 18, 22, and 26 weeks) during face-to-face interaction with the mother and a female stranger, who was also a mother. At all ages, there were differences in the proportion of time spent in particular "states" depending on who was the adult partner. For example, infant-mother dyads engaged in more turn-taking ("protocommunication") than did infant-stranger dyads. Patterns of state transitions also differed depending on the identity of the adult. This study in particular is an example of the complexity involved in conducting discrimination research in a semi-naturalistic context. Allowing the adults to vary their behavior, while more valid ecologically, makes it difficult to infer the basis of infant

discriminations--as noted by Olson (1981), it is not clear whether it involves "recognition" of familiar behavioral schemes or the adult's identity per se (cf. Rafman, 1974).

Both Hulsebus (1973) and Wahler (1967) reported infants to be more responsive to mother than stranger during a condition of contingent stimulation; i.e., the adult "reinforced" the infant by talking and smiling following the emission of a particular behavior (e.g., vocalization). Hulsebus (Exp. 2) found this greater responsiveness to the mother even when the stranger was an experienced caregiver. Greater responsiveness to the mother was also found during a noncontingent stimulation condition, but this may have been due to carry-over effects, since it always followed the contingent condition.

Finally, Hayes and Watson (1981) conducted two experiments in which the social stimuli were presented on videotape. In Exp. 1, 14- and 20-week-old infants observed sequential exposures of their parents and a male and female stranger in both 0° and 90° orientations. Due to complex order effects, data were collapsed across age and sex and only the first stimulus that each infant observed was analyzed. In the 0° orientation, infants smiled longer at mother than at father and male stranger; the difference between mother and female stranger approached significance. No differences in smiling time were found when the adults were presented in the 90° orientation. In Exp. 2, 14-week-olds were exposed to mother and female stranger in both 0°

and 90° orientations. Changes in order of exposure eliminated the order effects found in Exp. 1. Infants smiled longer at mother than at stranger in the 0° orientation but not in the 90° orientation.

OLFACTORY AND KINESTHETIC DISCRIMINATION

Two studies have evaluated infants' discrimination of social objects based on either olfactory or kinesthetic cues. Macfarlane (1975, Exp. 2) studied neonates' head turning as an index of preference for the breast pad of their own breast-feeding mother vs. the breast pad of another breast-feeding mother. One group (n=32) was tested at 2 and 6 days after birth, and a second group (n=32) was tested 8-10 days after birth. The infants were placed on their backs for two 1-minute trials during which they were free to turn their heads either toward their own mother's breast pad or toward another mother's breast pad. Head turning was randomly distributed at 2 days, but at 6 days 22 of the infants turned their heads more often toward their own mother's breast pad. The infants tested at 8-10 days spent a significantly greater percentage of their total turning time toward their mother's breast pad.

Gekoski (1974) examined the success of mothers and female strangers in quieting distressed infants on the basis of kinesthetic and visual cues.[5] Thirteen infants were seen in the home twice a month between 2 and 6 months and again at 10 months. Each month, success in quieting was observed once with the mother and once with a stranger, with the two

sessions typically separated by two days. Infants were placed in a common location (e.g., the crib), and following 60 seconds of crying, they were picked up by one of the adults and held close to her body in an upright position. A trial ended either 30 seconds after crying ceased or after 2 minutes of sustained distress. This procedure was repeated a total of three times but only the data for trial one will be reported here.

At all ages, Gekoski found that a majority of the infants either stopped crying before they were picked up or could not be soothed. Because the adults did not talk, it appears that the sound of the adult approaching the infant was responsible for the cessation of crying before contact. For reasons that are not entirely clear, the data for the latency of cessation to crying were anaylyzed only for infants at 2, 6, and 10 months. Among the infants who were quieted on the basis of contact, more were soothed by mother than by stranger, though this effect was significant only for females at 2 and 6 months. Although these findings are quite interesting, at least two caveats are necessary. First, only a small percentage of the infants provided usable data; second, the strangers were university students who probably had had little experience with infants. It is possible, therefore, that lack of skill in soothing contributed to the infants' sense that the kinesthetic "scheme" was not right.

INTERMODAL KNOWLEDGE

A final approach that has relevance for the study of

social discrimination in early infancy is derived from a rapidly developing body of research that Spelke (1976), among others, has termed "intermodal knowledge." As applied to the study of social stimuli, this approach seeks to understand when and on what basis infants learn that specific components of social identity "go together." In one application, infants' reactions to spatial violations of "person schemas" have been examined; e.g., do infants note that the spatial separation of a face from a voice constitutes an aberrant event? A second application has examined infants' reactions to violations of person schemas within a common spatio-temporal framework; e.g., do infants detect discrepancies in social identity such as mother's face paired with stranger's voice? Finally, infants' ability to utilize information from one attribute of social identity in order to match that attribute with a second attribute has been evaluated under the rubric of a technique termed "intermodal exploration" (Spelke & Owsley, 1979).

Infants' intermodal knowledge of persons has been addressed in 8 studies (Table 1.4). The evidence that young infants appreciate the aberrant nature of spatial violations of person-schemas is equivocal and subject to a number of methodological and interpretive constraints. Aronson and Rosenbloom (1971) exposed eight infants 30-55 days of age to a situation in which the mother's voice was displaced 90° to the right or left of her body, a situation that followed a baseline condition in which the spatial location of the

mother's body and voice had been congruent. Aronson and Rosenbloom reported dramatic shifts in the infants' behavior after the mother's voice had been displaced:

> The infants began to exhibit signs of agitation and discomfort, including struggling movements of the arms, legs, and torso, vigorous mouthing of the tongue, and facial grimacing...in three cases, they pushed themselves forward in the chair, so that it was necessary for the experimenter to momentarily restrain them... (p. 1161)

The only behavior systematically evaluated was tongue protrusions, which occurred more often in the violation condition than during baseline. In a second experiment, four infants were tested in the same condition, except that the mother was not visible to her infant. No difference in the incidence of tongue protrusions between baseline and displacement was found. In a third experiment, three infants were tested as in the first, except that a stranger served as the social object. It was reported that all three infants "reacted with distress" after the shift in voice locus and that tongue protrusions were again more frequent in the displacement condition.

Although this study provided no evidence that infants recognized or discriminated their mothers per se, the findings were interpreted as evidence that very young infants understand the "spatial integrity" of two components of a social stimulus. As has been pointed out by a number of authors, the strength of this interpretation is weakened by numerous methodological problems. McGurk and Lewis (1974), for example, noted that fatigue effects could have accounted

for the greater distress in the violation condition, since it always followed the synchronized baseline. In addition, the records of infants who became distressed during baseline were discarded, thus artificially inflating the probability of finding more distress in the violation condition. Finally, Aronson and Rosenbloom's (1971) failure to provide data on interobserver reliability for their one formal dependent measure is troubling, given the observer's awareness of the two stimulus conditions.

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insert Table 1.4 about here

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In any case, three subsequent attempts to replicate Aronson and Rosenbloom's study did not find significant increases in distress following violation (Condry, Haltom, & Neisser, 1977; Lewis & Hurowitz, 1977; McGurk & Lewis, 1974), including a failure to find a greater incidence of tongue protrusions (Condry et al., 1977; McGurk & Lewis, 1974). However, McGurk and Lewis found that head turning and looking to the right and left occurred more often during the violation condition; this effect was significant only for infants 4- and 7-month-olds but not for 1-month-olds (cf. Lewis & Hurowitz, 1977). Condry et al. (1977) also failed to find more frequent head turning during violation with infants 1-2 months of age.

As Lewis and Hurowitz (1977) have noted, head turning during violation may simply reflect orientation to sound

rather than an appreciation that a perceptually unified audiovisual person schema has been violated. Alternatively, increased head turning may reflect attempts at understanding or exploring the "conflict" induced by face-voice separation (cf. Bower, 1982, p. 128). To rule out the first interpretation, a number of studies have violated the audiovisual person schema within a common spatio-temporal framework (Bigelow, 1977; Carpenter, 1973; Cohen, 1974; Lewis & Hurowitz, 1977). The results of these studies have been equivocal. Carpenter found no evidence that 2-7 week-olds looked more at their mother when her face was accompanied by her own voice as compared to a stranger's voice but did find that the discrepancy condition evoked more looking away than did either the congruent or the no-voice condition. Inspection of Carpenter's (1973) data indicates that this behavior occurred, on average, for less than 1 second per 30 second interval of exposure time, a dubious finding to say the least.

Compared to the normal condition of matching mother or stranger's face and voice, Lewis and Hurowitz (1977) reported more looking to the right, left, front, and down when the adult's voice was either displaced or mismatched with a face and even when the adult's face or voice was presented alone. Given that the same behavior occurred in so many conditions, it is not clear whether the meaning of the behavior can be interpreted parsimoniously. On the basis of visual regard, Bigelow (1977) found no evidence for differential reactions

to face-voice discrepancies in 5-week-olds but did find that 13-week-olds had longer first fixations in discrepant as oppposed to congruent face-voice conditions. Cohen (1974), who also employed measures of visual regard, found no evidence for differential reactions at 22 weeks but some at 35 weeks. On the whole, these studies provide little convincing evidence that infants under the age of 12 weeks are sensitive to violations of adult social identity.

Spelke and Owsley (1979) evaluated infants' ability to match one attribute of social identity with a second attribute. In a first experiment, infants 15, 22, (and 33) weeks of age heard one parent's voice projected through a speaker that was equidistant between the mother and the father. Each parent's voice was presented eight times. At all ages, the infants were more likely to look first at the parent whose voice was presented. A second experiment replicated this finding for infants 15 weeks of age; however, when the voices of the mother and a female stranger were presented, the infants were more likely to look first at the silent adult. Although this last finding is difficult to interpret, Spelke and Owsley's other findings do suggest that infants, at least by the age of 15 weeks, are capable of matching two attributes of social identity.

DISCUSSION

What implications might be drawn from these data with regard to theoretical and clinical issues in infant social development? A number of years ago, both Bowlby (1969) and

Ainsworth (1973) attempted to identify "phases" in the development of attachment relations. The first phase of attachment that they described was characterized by "undiscriminating social responsiveness." It spanned roughly the "first two or three months of life," during which the infant was seen as especially sensitive to stimuli that came from people but as being unable to "discriminate between the persons presenting these stimuli" (Ainsworth, 1973). It was suggested that "tactile-kinesthetic discrimination may come first and auditory discrimination next, but visual discrimination is unlikely to occur earlier than eight weeks of age" (Ainsworth, 1973, p. 11).

The data reviewed here indicate the need for some modifications in the conceptualization of this phase. In the auditory domain, for example, discriminations between social stimuli appear to be made earlier than was once thought, at least under the conditions of testing devised by researchers. On the other hand, little change appears to be called for in terms of when infants can be said to discriminate between social objects on the basis of visual cues. Even Bushnell's (1982) recent study with 5-week-olds seems to show that infants are capable of distinguishing only parts of faces.

Even if advances in technique continue to lower the age at which confident conclusions regarding discrimination can be made, it is not clear that this will call for revisions in our thinking about the infant's social development. To date, the sensitivity that infants show in their discriminations

between social stimuli accounts for far less of the variance than do other stimulus properties. Among the studies reviewed in this chapter, for example, facial orientation and movement were far more salient to the infant than was adult social identity (cf. Sherrod, 1981). In this context, what we continue to learn about infants' early social discriminations needs to be evaluated against the backdrop of the far more dramatic changes that occur in social cognition and perception by the end of the first year or two of life.

As noted by Sears (1975), developmentalists have historically vacillated in their focus on "basic" vs. "mission-oriented" research. Part of the reason for this is that "scientific wisdom" has replaced "folk wisdom" as the main source of advice regarding the understanding and rearing of infants and children in our culture (Whiting, 1974). Given this responsibility, it is important that the accuracy of "institutionalized" proclamations regarding development be carefully monitored. As a tentative application of such monitoring to the period covered by this review, consider what has been said about "reactive attachment disorder of infancy," a new diagnostic entity in the third edition of the American Psychiatric Association's (1980) Diagnostic and Statistical Manual of Mental Disorders (DSM-III). In general, the inclusion of such a diagnosis represents an official recognition that infants, too, have their problems. But how accurate are the criteria for this "disorder"? One of the criteria concerns age of onset. DSM-III states that

it is "always before eight months, since attachments are formed by eight months if there has been adequate caretaking" and that the diagnosis can be made "as early as in the first month of life." To the extent that discrimination of social stimuli is a "necessary condition" (Ainsworth, 1973) for attachment behavior, the general pattern of the data reviewed here lends little support to the claim that such a diagnosis can be made in the first month of life (cf. Rutter & Shaffer, 1980). Although in general the DSM-III description of the features of reactive attachment disorder seems reasonable, this example illustrates how the findings from basic research can be interpreted in an unreasonable manner. In this regard, we might recall Williams James's assertion that a difference, in order to be a difference, has to make a difference.

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FOOTNOTES

[1] The phrase "evidence of discrimination" is meant to convey the conclusion of the author(s) of each study. It does not necessarily imply that the critical reader would reach the same conclusion.

[2] Of the 20 studies listed in Table 1, 4 reported that the adults smiled (including Watson's [1966] adults who displayed a "non-toothy grin"), 7 reported that the adults were "expressionless" or "unresponsive," and 9 did not provide the relevant information.

[3] In Table 1 of Dixon et al. (1981) one of the reported differences between mother and father was "gaze away" but in the text it is stated that there were "no differences in the gaze patterns of the infants in the three interactive settings" (p. 37).

[4] As an aside, it should be noted that there are numerous typographical errors, or at least apparent ones, in the Dixon et al. (1981) report (see particularly, Table 2), which does not help the reader evaluate their claims.

[5] Gekoski (personal communication) reports that infants had the opportunity to see the adult before and during the trial, but did not always do so (e.g., some infants kept their eyes closed). Systematic recording of the infants' visual behavior was not made.

Table 1.1: Visual Discrimination Studies

Study	Age (in wks)	n	Independent Variable	Dependent Variable	Mode and Format of Stimulus Presentation	Stimulus Exposure Time	Sex and No. of Strangers	Blind Observer	Discards	Comment
Carpenter (1973)	2 to 7* (long.)	19	social identity (M,S)	visual regard	live; sequential exposure	30 seconds/adult X2	Female 1	No	ND	tested only females; infants exposed to other stimulus conditions (see Tables 1.3-1.4)
Haith et al. (1977)	3-5 7 9-11	8 8 8	social identity (M,S) head movement (still, side-to-side)	visual regard	mirror-reflected; sequential exposure	45 seconds/adult/movement condition	Male and Female ND	NA	8 7 7	infants exposed to other stimulus condition (see Table 1.3); within each age group, half of the infants were exposed to a male stranger, the other half to a female stranger
Melhuish (1982)	3.4-5	31	social identity (M,S) facial orientation (0°,45°)	visual regard	live; sequential exposure	30 seconds/adult/orientation	Female 1	Yes	11	infants exposed to other stimulus condition (see Table 1.3)
Sherrod (1979)	4 12 20*	20 20 20	social identity (M,S)	visual regard	live; paired-comparison	30 seconds; total, 120 seconds/adult (see comment)	Female 5	Yes	20	each face was also paired with 3 other stimuli (mannequin, schematic face, and geometric stimulus [5 exemplars each])
Lewis & Hurowitz (1977)	4 16	7 10	social identity (M,S)	visual regard, smile/laugh, frown, fret/cry	live; sequential exposure	30 seconds/adult	Female 1	Yes(?)	ND	infants exposed to other stimulus conditions (see Tables 1.2-1.4)
Maurer & Salapatek (1976)	4.6* 9.2	6 6	social identity (M,S)	visual regard	mirror-reflected; sequential exposure	75 seconds/adult	Female 2 Male 4	No	0	each infant exposed to one male and one female stranger; observer blind to infant's age

Table 1.1 (cont.)

Study	Age (in wks)	n	Independent Variable	Dependent Variable	Mode and Format of Stimulus Presentation	Stimulus Exposure Time	Sex and No. of Strangers	Blind Observer	Discards	Comment
Fitzgerald (1968)	4.7 8.5 17.0*	10 10 10	social identity (M,S)	pupillary activity	black and white photographs presented on videotape; sequential exposure	20 seconds/adult (see comment)	Female 1	NA	0	infants exposed to 3 other stimuli (4-sq checkerboard, 144-sq checkerboard, triangle); stranger's face taken from a "popular" magazine; inter-stimulus intervals ranged from 10-30 seconds; data analysis limited to 5 second interval preceding and following stimulus presentation (change scores); infants retested if they deviated from quiet-alert state
Bigelow (1977)	5 13*	12 12	social identity (M,S)	visual regard	live; sequential exposure	45 seconds/adult X2	Female 1(?)	ND	ND	infants exposed to other stimulus conditions (see Tables 1.3-1.4); counterbalancing of stimuli not mentioned; reliability and statistical analyses not given
Bushnell (1982)	5.2* 11.7* 18.7*	10 10 10	social identity (M,S) facial information (normal, standardized [eyes, hair, mouth, and eyes and hair])	visual regard	colored slides; habituation-dishabituation paradigm	variable (infant control procedure); in each facial information condition, habituated to mother's face; then shown stranger's face for 3 30 second trials	Female 6 (1/facial information condition)	No(?)	0 1 1	"each infant made up to seven laboratory visits over a period extending to 3 weeks, with two test conditions normally being completed on each visit" (p. 301); in a control condition, mother's normal face shown in both habituation and test; each trial began following first fixation; separate analyses performed on each age group; no formal reliability

Table 1.1 (cont.)

Study	Age (in wks)	n	Independent Variable	Dependent Variable	Mode and Format of Stimulus Presentation	Stimulus Exposure Time	Sex and No. of Strangers	Blind Observer	Discards	Comment
Watson (1966, Exp. 2)	7-8 13-14 19-20 25-26	12 12 12 12	social identity (M,S) facial orientation (0°,90°, 180°)	smiling	live; sequential exposure	30 seconds/adult/ orientation	Male 1	Yes	ND	infants also exposed to a multi-colored cloth mask worn by E in each of the 3 facial orientations; no formal reliability
Lamb & McCluskey (1974)	10 (11)	48	social identity (M,S)	visual regard	colored slides; habituation-dishabituation paradigm	variable (infant control procedure)	Female 1	Yes	11	present and other stimulus condition (see Table 1.3) counterbalanced across 10- and 11-week sessions; experimental group infants (n=24) always habituated to mother's face; control group infants exposed either to mother's (n=12) or stranger's (n=12) face during habituation and test
Hayes & Watson (1981, Exp. 2)	10 14	12 12	social identity (M,S)	smiling	colored videotape; sequential exposure	30 seconds/adult	Female 1	Yes	8	infants exposed to other stimulus conditions (see Table 1.3)
Barrera & Maurer (1978)	12*	14	social identity (M,S)	visual regard	colored slides; paired-comparison (phase 1); familiarization-test (phase 2)	20 seconds X2 (phase 1); familiarization was 100 seconds and test was 20 seconds X2	Female 14	Yes(?)	ND	during familiarization (phase 2), infants exposed to two pictures of their mothers simultaneously; during test, infants exposed to picture of mother and stranger simultaneously (paired-comparison); stranger used in test same as one used in phase 1; a second group of infants (n=12) exposed to same procedure but only with strangers; reliability and statistical analyses not given

Table 1.1 (cont.)

Study	Age (in wks)	n	Independent Variable	Dependent Variable	Mode and Format of Stimulus Presentation	Stimulus Exposure Time	Sex and No. of Strangers	Blind Observer	Discards	Comment
Maurer & Heroux (1980, Exp. 1)	12*	20	social identity (F,S)	visual regard	colored slides; habituation-test	habituation phase variable (infant control procedure); test trials (2 with father, 2 with stranger) ended once infant looked away	Male 20	ND	ND	during habituation, infants exposed to their father's picture; each trial ended when infant looked away; on test, order of exposure to father and stranger counterbalanced across infants; second group of infants (n=20) were exposed to same procedure but only with strangers
Maurer & Heroux (1980, Exp. 2)	12*	16	social identity (M,F,S)	visual regard	colored slides; sequential exposure	variable (infant control procedure); each face shown X2; trial ended once infant looked away	Female 16 Male 16	ND	ND	order of exposure to male and female faces counterbalanced such that half the infants saw the female faces first and half the infants saw the male faces first
Barrera & Maurer (1981	12.6*	12	social identity (M,S)	visual regard	colored slides; sequential exposure (phase 1); habituation-test (phase 2)	variable (infant control procedure); each face shown X2; trial ended once infant looked away; habituation variable (infant control procedure); in test, mother's face and stranger's face each shown X2; trial ended once infant looked away	Female 1 (phase 1) 12 (phase 2)	Yes	8	in phase 2, infants always habituated to mother's face

Table 1.1 (cont.)

Study	Age (in wks)	n	Independent Variable	Dependent Variable	Mode and Format of Stimulus Presentation	Stimulus Exposure Time	Sex and No. of Strangers	Blind Observer	Discards	Comment
Brown (1975)	12.9*	12	social identity (M,S)	visual regard, smiling, vocalizing	live; sequential exposure	4 trials/adult; 23 seconds/trial	Female 12	Yes	3	two other groups of infants exposed to other stimulus conditions (see Tables 1.2-1.3)
Watson et al. (1979)	14* 20*	16 16	social identity (M,S) facial orientation (0°,90°)	smiling	live; sequential exposure	30 seconds/adult/ orientation	Male 1	No	ND	infants exposed to other stimulus condition (see Table 1.3); no formal reliability
Wahler (1967)	14.3	13	social identity (M,S)	smiling	live; sequential exposure	300 seconds/adult	Female 13	No	2	exposure to adults separated by 1-2 days; following exposure to one adult, another stimulus condition occurred (see Table 1.3); interpretation of this study based on re-analysis of Wahler's data (available upon request)
Contole & Over (1981)	14.7	6	social identity (M,S)	visual regard, smiling, crying, arm movement	live; sequential exposure	120 seconds/adult	Female 1	Yes	0	same infants tested at 29.6 weeks; infants also exposed to an alone condition and with adults talking (see Table 1.3); for each adult, infants' behavior was based on a 20 second segment of the trial selected at random; see also Contole & Over (1979)
Bernard & Ramey (1977)	16* 24*	12 12	social identity (M,S,I)	visual regard, vocalizing	colored slides; paired-comparison	30 seconds/pair X2 total exposure/ stimulus, 120 seconds	Female 1	ND	0	one infant (20 weeks), sex not specified, was used as the peer; three infants re-tested due to distress or fatigue

* Author(s) reported evidence of discrimination; M=mother; F=father; S=stranger; I=infant peer; NA=not applicable; ND=no data

Table 1.2: Auditory Discrimination Studies

Study	Age (in wks)	n	Independent Variable	Dependent Variable	Mode and Format of Stimulus Presentation	Stimulus Exposure Time	Sex and No. of Strangers	Blind Observer	Discards	Comment
DeCasper & Fifer (1980, Exp. 1)	less than 3 days*	10	social identity (M,S)	non-nutritive sucking	tape-recorded voices; sucking pattern determined which voice would be activated and maintained	1200 seconds (maximum)	Female 10	Yes	2	
Decasper & Fifer (1980, Exp. 2)	less than 3 days*	16	social identity (M,S)	non-nutritive sucking	tape-recorded voices; sucking pattern determined which voice would be activated	1200 seconds (maximum)	Female 16	Yes	3	tested only females; see also Fifer (1981)
Hulsebus (1983, Exp. 1)	3 days	21	social identity (F,S)	vocal distress	live voices; sequential exposure	60 seconds/voice	Male 1	No	ND	order effects not evaluated
Hulsebus (1983, Exp. 2)	1.0*	22	social identity (F,S)	vocal distress	live voices; sequential exposure	60 seconds/voice	Male 1	No	ND	order effects not evaluated
Hulsebus (1975)	1.9*	14	social identity (M,S)	vocal distress	live voices; sequential exposure	60 seconds/voice	Female 1	No	3	order effects not evaluated
Hulsebus (1981)	2.3*	24	social identity (F,S)	vocal distress	live voices; sequential exposure	60 seconds/voice	Male 1	No	ND	order effects not evaluated
Mills & Melhuish (1974)	3.4*	32	social identity (M,S)	non-nutritive sucking	live voices; sequential exposure; sucking (at least 5 mm of water pressure controlled voice presentation	180 seconds/voice (maximum)	Female multiple	NA	ND	a control condition (n=16) involved non-contingent voice onset schedule; discrimination phase preceded by 6 minute contingency training period

Table 1.2 (cont.)

Study	Age (in wks)	n	Independent Variable	Dependent Variable	Mode and Format of Stimulus Presentation	Stimulus Exposure Time	Sex and No. of Strangers	Blind Observer	Discards	Comment
Lewis & Hurowitz (1977)	4 16	7 10	social identity (M,S)	visual regard, smile/laugh, frown, fret/cry	live voices (speaker projected); sequential exposure	30 seconds/voice	Female 1	Yes	ND	infants exposed to other stimulus conditions (see Tables 1.1, 1.3-1.4)
Mehler et al. (1978)	4.7-5.1*	40	social identity (M,S) voice rhythmicity (intonated, monotone)	non-nutritive sucking	tape-recorded voices; sucking rate activated voice; sequential exposure	5 trials/voice; 20 seconds/trial	Female 40	NA	12	
Boyd (1974)	8*	24	social identity (M,S)	visual regard	tape-recorded voices; fixation of non-social stimulus activated voice	variable (infant control procedure)	Female 1	Yes	16	n=12 in experimental and control groups, respectively; same subjects tested in 7.1 weeks in similar procedure (see text)
Brown (1975)	12.9*	12	social identity (M,S)	visual regard, smiling, vocaling	live voices; sequential exposure	adult said "Hello baby, how are you today" X3 during a 23 second trial; 4 trials/voice	Female 12	Yes	8	two other groups of infants exposed to other stimulus conditions (see Tables 1.1 and 1.3)
Turnure (1971)	13.3* 25.1	5 6	social identity (M,S)	limb movement, smiling, frowning, crying, mouthing, vocalizing, limb-mouth contact	tape-recorded voices	60 seconds/voice (preceded and followed by 30 second control periods)	Female 1	Yes(?)	not given formally	also studied 36 week-old infants; prior to present conditions, infants exposed to mother's voice in normal and distorted form; in present condition, also exposed to mother's voice in distorted form; mother's voice always preceded stranger's voice; no formal reliability

Table 1.2 (cont.)

Study	Age (in wks)	n	Independent Variable	Dependent Variable	Mode and Format of Stimulus Presentation	Stimulus Exposure Time	Sex and No. of Strangers	Blind Observer	Discards	Comment
Brown (1979)	16.4*	40	social identity (M,F,S)	vocalizing	live voices; between-subjects design	adult said "Hello baby, how are you today" at beginning of each of three 30 second intervals; each interval followed by 30 seconds of silence	Female 10 Male 10	No	1	
Bosso (1978)	20*	20	social identity (M,S)	arm pulls; positve and negative vocalizations; smiling; visual search; alerting	tape-recorded voices; sequential exposure	5 minutes (maximum); arm pull (110 g) activated voice; voice remained on as long as arm was in flexed position	Female 20	No	26	exposure to voices preceded by a 4 minute training trial in which a bell served as the reinforcer; exposure to two voices separated by a 1 minute extinction trial; extinction trial; with the exception of arm pulls, n=12 for remaining dependent measures

* Author(s) reported evidence of discrimination; M=mother; F=father; S=stranger; NA=not applicable; ND=no data

Table 1.3: Multisensory Discrimination Studies

Study	Age (in wks)	n	Independent Variable	Dependent Variable	Mode, Format, and Type of Stimulus Presentation	Stimulus Exposure Time	Sex and No. of Strangers	Blind Observer	Discards	Comment
Carpenter (1973)	2 to 7* (long.)	19	social identity (M,S)	visual regard	live (voices tape-recorded); sequential exposure; visual and auditory	30 seconds/adult X2	Female 1	No	ND	tested only females; infants exposed to other stimulus conditions (see Tables 1.1, 1.4); adults mimed the words that came from a speaker 26 inches below the face
Dixon et al. (1981)	2 to 24* (long.)	5	social identity (M,F,S)	facial expression (frown, neutral, smile), vocalizations (cry, none, coo), limb movement (none, small, large), gaze (away, interrupted, toward)	live; sequential exposure; visual, auditory, and tactile	120 seconds/adult for each testing session	Male and Female Multiple	Partial	0	see text for no. of sessions; stranger never saw the same infant more than once; three "tapes" scored with observer blind to adult social identity; remainder not blind
Haith et al. (1977)	3-5 7 9-11	8 8 8	social identity (M,S) head movement (still, side-to-side)	visual regard	mirror-reflected faces; sequential exposure; visual and auditory	45 seconds/adult/ head movement condition	Male and Female MD	NA	8 8 7	infants exposed to other stimulus condition (see Table 1.1); within each age group, half of the infants were exposed to a male stranger, the other half to a female stranger
Melhuish (1982)	3.4-5	31	social identity (M,S) voice quality (neutral, affective)	visual regard	live; sequential exposure; visual and auditory	30 seconds/adult/ voice quality condition	Female 1	Yes	11	infants exposed to other stimulus condition (see Table 1.1); in present condition, there was also 1 trial/adult in which the face was averted 45° with affective voice

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Table 1.3 (cont.)

Study	Age (in wks)	n	Independent Variable	Dependent Variable	Mode, Format, and Type of Stimulus Presentation	Stimulus Exposure Time	Sex and No. of Strangers	Blind Observer	Discards	Comment
Klein & Jennings (1979)	4 12* 20* (long.)	31 36 29	social identity (M,S)	visual regard, smiling, vocaling, movement of limbs, head, or trunk	live; sequential exposure; visual and auditory	60 seconds/adult X2	ND 1	No	7 2 9	total n before discards, 38; infants also exposed to a rotating, musical mobile; two exposures to the stimuli generally separated by two days; no formal reliability
Lewis & Hurowitz (1977)	4 16	7 10	social identity (M,S)	visual regard, smile/laugh, frown, fret/cry	live (voices transmitted through speaker); sequential exposure; visual and auditory	30 seconds/adult	Female 1	Yes(?)	ND	infants exposed to other stimulus conditions (see Tables 1.1, 1.2, and 1.4)
Bigelow (1977)	5* 13*	12 12	social identity (M,S)	visual regard	live (voices tape-recorded); sequential exposure; visual and auditory	45 seconds/adult X2	Female 1(?)	ND	ND	infants exposed to other stimulus conditions (see Tables 1.1, 1.4); adults gave "lip synchronization" to tape; tape recorder held at head level behind adult; counterbalancing of stimuli not mentioned; reliability and statistical analyses not given
Fogel (1979)	5-14*	18	social identity (M,I)	multiple behavioral categories, including gaze, facial expression, limb movement, and body position (total n=34)	live; sequential exposure; visual and auditory	120 seconds/stimulus	Male and Female 18	No	0	primary unit of analysis was the 10-second period following the infant's first look at social object; a second 10-second period was analyzed for those infants who subsequently looked away and then back at the social object (for mother, n=6; for infant peer, n=7); also studied infants in a 2 minute alone condition

Table 1.3 (cont.)

Study	Age (in wks)	n	Independent Variable	Dependent Variable	Mode, Format, and Type of Stimulus Presentation	Stimulus Exposure Time	Sex and No. of Strangers	Blind Observer	Discards	Comment
Blehar et al. (1977)	6-15*	26	social identity (M,S)	smiling, vocalizing; bouncing, fussing, visual regard, intensity of response, termination of response	live; episodes of face-to-face interaction; visual, auditory, and tactile	epidodes recorded within 4 hour observation time/session	Female 2 Male 2	No	0	observed at 3-week intervals; tactile interaction did not necessarily accompany every episode of interaction; individual infants exposed to one particular stranger
Banks & Wolfson (1967)	6.9* 11.9*	26 26	social identity (M,S)	heart-rate	live; between subjects design; visual and auditory	60 seconds	Female 1	NA	ND	exposure to adults preceded and followed by 60 seconds alone; original design included exposure to both adults but due to order effects, only first exposure analyzed
Koch (1968)	8* 12*	20 20	social identity (M,S)	head-turning	live; between subjects design; visual and auditory	10 sessions (12-15 minutes); 10 trials/session; 1 session/day	Male(?) 1(?)	No	ND	no formal reliability; sex and no. of strangers inferred from Koch (1967)
Fogel (1980, Exp. 1)	10*	20	social identity (M,S)	gaze at, gaze away, distress brow, yawn, cry, rhythmic mouth movement, shielding body or face, arm extension	live; sequential exposure; visual and auditory (and possibly tactile)	120 seconds/adult	Female 1	Yes	ND	adult sessions preceded and followed by a 60 second alone session; five other behaviors not included due to low frequency of occurrence
Fogel (1980, Exp. 2)	10	20	social identity (M,S)	same as above	live; sequential exposure; visual and auditory (and possibly tactile)	120 seconds/adult	Female 1	Yes	ND	same as above except stranger interacted with infant for 10 minutes prior to start of sessions

Table 1.3 (cont.)

Study	Age (in wks)	n	Independent Variable	Dependent Variable	Mode, Format, and Type of Stimulus Presentation	Stimulus Exposure Time	Sex and No. of Strangers	Blind Observer	Discards	Comment
Laub & McCluskey (1974)	10* (11)	48	social identity (M,S)	visual regard	colored slides and tape-recorded voices (speaker below screen); habituation-dishabituation paradigm; visual and auditory	variable (infant control procedure)	Female 1	Yes	11	present and other stimulus condition (Table 1.1) counterbalanced across 10- and 11-week sessions; experimental group infants (n=24) always habituated to mother's face and voice; control group infants (n=24) exposed either to mother's (n=12) or stranger's (n=12) face and voice during habituation and test
Hayes & Watson (1981, Exp. 2)	10 14*	12 12	social identity (M,S) facial orientation (0°,90°)	smiling	colored videotape; sequential exposure; visual and auditory	30 seconds/adult/orientation	Female 1	Yes	8	infants exposed to other stimulus condition (see Table 1.1)
Roe (1978)	12* 20* (long.)	12	social identity (M,S) Gesell DQ (high, low)	smiling, motor activity, vocalizing (positive and negative)	live; sequential exposure; visual and auditory	180 seconds/adult	Female 1	No	ND	tested only males; infants also studied at 28 and 36 weeks; DQ obtained at 36 weeks; exposure to mother always occurred first; no formal reliability except for vocalizations
Hulsebus (1973, Exp. 1)	12-13*	4	social identity (M,S)	smiling, positive and neutral vocalizing, arm lifting, vocal distress	live; sequential exposure; visual and auditory (smiling and vocalizing for 7 seconds contingent upon presence of infant smiling and/or vocalizing	300 seconds/adult; one session/day over a period of at least 4 weeks; actual no. of sessions could not be determined	Female 4	No	0	followed a number of baseline sessions in which adults were available visually; these data are not presented in Table 1.1 because of insufficient information; three of the infants were exposed to one stranger; the remaining infant was exposed to two strangers (reason not specified)

Table 1.3 (cont.)

Study	Age (in wks)	n	Independent Variable	Dependent Variable	Mode, Format, and Type of Stimulus Presentation	Stimulus Exposure Time	Sex and No. of Strangers	Blind Observer	Discards	Comment
Hulsebus (1973, Exp. 2)	12-15* (long.)	16	social identity (M,S)	smiling, positive and neutral vocalizing, arm lifting, vocal distress	live; sequential exposure; visual and auditory; contingent stimulation given as in Exp. 1; non-contingent stimulation given once every 15 seconds	300 seconds/adult (contingency); 180 seconds/adult (noncontingency); total of 4 sessions, 1/week	Female 16	No	0	tested at weekly intervals; within each session, contingent condition always preceded non-contingent condition; with the exception of tw infants, all exposed to only one stranger
Brown (1975)	12.9*	12	social identity (M,S)	visual regard, smiling, vocalizing	live; sequential exposure; visual and auditory	23 seconds/adult; 4 trials/adult	Female 12	Yes	3	two other groups of infants exposed to other stimulus conditions (see Tables 1.1 and 1.2)
Rebelsky (1971)	12-15*	9	social identity (M,S)	smiling, head turning, motor activity, positive vocalization	live; sequential exposure; visual and auditory	30 seconds/adult X3	Female 1	No	ND	exposure to each adult followed by 30-second interval of adult present but silent; these data are not reported in Table 1 because session always followed the visual-auditory session; order of exposure to adult not counterbalanced; each adult presented once before repeating; adult facial orientation may have been 90°
Fafouti-Milenkovic & Uzgiris (1979)	14* 18* 22* 26*	12 12 12 12	social identity (M,S)	adult-infant "states" (n=6)	live; sequential exposure; visual and auditory (possibly tactual)	150 seconds/adult	Female multiple	Yes	ND	see Fafouti-Milenkovic & Uzgiris (1979) for definitions of the adult-infant states; also studied interaction with adult use of toys but these data were not analyzed

Table 1.3 (cont.)

Study	Age (in wks)	n	Independent Variable	Dependent Variable	Mode, Format, and Type of Stimulus Presentation	Stimulus Exposure Time	Sex and No. of Strangers	Blind Observer	Discards	Comment
Hayes & Watson (1981, Exp. 1)	14* 20*	16 16	social identity (M,F,S) facial orientation (0°,90°)	smiling	colored videotape; sequential exposure; visual and auditory	30 seconds/adult/orientation	Female 32 Male 32	partial	18	complex order effects; as a result, analyzed only first stimulus presentation (n=4/cell); observers were probably blind to adult social identity but not to adult sex
Watson et al. (1979)	14* 20*	16 16	social identity (M,S) facial orientation (0°,90°)	smiling	live; sequential exposure; visual and auditory	30 seconds/adult/orientation	Male 1	No	ND	infants exposed to other stimulus condition (see Table 1.1); no formal reliability
Wahler (1967)	14.3*	13	social identity (M,S)	smiling	live; sequential exposure; visual, auditory, and tactile (every time infant smiled, adult smiled, talked, and touched infant); otherwise, adult remained visible but silent	300 seconds/adult	Female 13	No	2	exposure to adults separated by 1-2 days; for each adult, present condition preceded by a baseline condition of visual presence (see Table 1.1)
Contole & Over (1981)	14.7	6	social identity (M,S)	visual regard, smiling, crying, arm movement	live; sequential exposure; visual and auditory	120 seconds/adult	Female 1	Yes	0	same infants tested at 29.6 weeks; infants also exposed to an alone condition and with adults silent (see Table 1.1); for each adult, infant's behavior based on a 20 second segment of the trial selected at random; see also Contole & Over (1979)

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Table 1.3 (cont.)

Study	Age (in wks)	n	Independent Variable	Dependent Variable	Mode, Format, and Type of Stimulus Presentation	Stimulus Exposure Time	Sex and No. of Strangers	Blind Observer	Discards	Comment
Lasky & Klein (1979)	20*	80	social identity (M,S) eye contact with infant (yes/no)	visual regard, smiling, vocalizing, (positive and negative)	live; between-subjects design (social identity/ order of eye contact); visual and auditory	60 seconds/eye contact condition	Female 1	No	ND	observer blind to eye contact condition; no formal reliability
Cohen (1974)	22.1*	24	social identity (M,S)	visual regard, smiling, fret/ cry, vocalizing, mouthing	live (voices tape-recorded); sequential exposure (see comment); visual and auditory	17-22 seconds/adult X2	Female 8	Yes	0	also studied infants 35.2 weeks old; infants exposed to other stimulus condition (see Table 1.4); adults gave "lip synchronization" to tape; speaker held at shoulder level; both adults in infant's visual field during session; each mother's voice served as stranger's voice

* Author(s) reported evidence of discrimination; M=mother; F=father; S=stranger; I=infant peer

Table 1.4: Studies of Intermodal Person Knowledge

Study	Age (in wks)	n	Independent Variable	Dependent Variable	Mode, Format, and Type of Stimulus Presentation	Stimulus Exposure Time	Sex and No. of Strangers	Blind Observer	Discards	Comment
Carpenter (1973)	2 to 7 (long.)	19	social identity discrepancy (M,S)	visual regard	live (voices tape-recorded); sequential exposure; visual-auditory discrepancy (mother's face-stranger's voice; stranger's face-mother's voice)	30 seconds/stimulus X2	Female 1	No	ND	tested only females; infants exposed to other stimulus conditions (see Tables 1.1, 1.3); adults "mimed" the words that came from a speaker 26 inches below the face
Lewis & Hurowitz (1977)	4 16	7 10	social identity discrepancy and violation (M,S)	visual regard, smile/laugh, frown, fret/cry	live (voices transmitted through speaker); sequential exposure; visual-auditory discrepancy (as in Carpenter, see above) and visual-auditory displacement (mother's voice displaced 90° from her face, same for stranger)	30 seconds/stimulus	Female 1	Yes(?)	ND	infants exposed to other stimulus conditions (see Tables 1.1-1.3)
McGurk & Lewis (1974)	4 16	11 12	social identity violation (M)	visual regard, smiling, frown, fret/cry, vocalizing, tongue protrusion	live (voice transmitted through speaker); visual-auditory displacement (as in Lewis & Hurowitz, see above); in control condition, no voice displacement	30 seconds for violation X2; 30 seconds for control X2	NA NA	Yes	ND	also tested infants 28 weeks old; first and last 30 seconds of session were control periods
Aronson & Rosenbloom (1971)	5.9 (min)	8	social identity violation (M)	tongue protrusion	live (voice transmitted through speaker); visual-auditory displacement (as in Lewis & Hurowitz, see above); in control condition, no voice displacement	45 seconds for violation (?); 120 or 300 seconds for control	NA	ND	ND (see text)	control condition always preceded displacement condition; no formal reliability; Exp. 2 repeated procedure except mother not visible (n=4, age range, 4-8 weeks); Exp. 3 same as Exp. 1 except female stranger served as social object

Table 1.4 (cont.)

Study	Age (in wks)	n	Independent Variable	Dependent Variable	Mode, Format, and Type of Stimulus Presentation	Stimulus Exposure Time	Sex and No. of Strangers	Blind Observer	Discards	Comment
Aronson & Rosenbloom (cont.)										(n=3, age not given)
Bigelow (1977)	5 13	12 12	social identity discrepancy (M,S)	visual regard	live (voices tape-recorded); sequential exposure; visual-auditory discrepancy (as in Carpenter, see above)	45 seconds/stimulus X2	Female 1(?)	ND	ND	infants exposed to other stimulus conditions (see Tables 1.1, 1.3); adults gave "lip synchronization" to tape; tape recorder held at head level behind adult; counterbalancing of stimuli not mentioned; reliability and statistical analyses not given
Condry et al. (1977)	7	8	social identity violation (M)	head position; tongue protrusion; emotional state	live (voice transmitted through speaker); visual-auditory displacement (as in McGurk & Lewis, see above); in control condition, no voice displacement	120 seconds for violation; 120 seconds for control	NA	Yes	ND	first and third minute of session were control periods
Spelke & Owsley (1979, Exp. 1)	14.9 22.3	9 9	social identity congruence (M,F)	visual regard	phase 1: live (tape recorded voices transmitted through speaker centered between adults) phase 2: live (each adult spoke in turn)	in both phases, each adult's voice was heard XB (range, 1-4 seconds/trial)	NA	Yes	3 (phase 1) 1 (phase 2)	also studied infants 31 weeks old; prior to voice onset, attempt was made to draw infant's gaze to a point midway between adults; data for trials in which this was unsuccessful were excluded from analysis

Table 1.4 (cont.)

Study	Age (in wks)	n	Independent Variable	Dependent Variable	Mode, Format, and Type of Stimulus Presentation	Stimulus Exposure Time	Sex and No. of Strangers	Blind Observer	Discards	Comment
Spelke & Owsley (1979, Exp. 2)	15.5	36	social identity congruence (M,F,S)	visual regard	same as phase 1 above	same as phase 1 above	Female multiple	Yes	2	between-subjects design; half of the infants exposed to mother-father condition; half exposed to mother-stranger condition
Cohen (1974)	22.1	24	social identity discrepancy (M,S)	visual regard, smiling, fret/cry, vocalizing, mouthing	live (voices tape-recorded); sequential exposure (see comment); visual-auditory discrepancy (as in Carpenter, see above)	17-22 seconds/adult X2	Female 8	Yes	0	also studied infants 35.2 weeks old; infants exposed to other stimulus condition (see Table 1.3); adults gave "lip synchronization" to tape; speaker held at shoulder level; both adults in infant's visual field during session; each mother's voice served as stranger's voice

M=mother; F=father; S=stranger; NA=not applicable; ND=no data